CLASSROOM GAMES

RENT SEEKING AND THE INEFFICIENCY OF NON-MARKET ALLOCATIONS

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Abstract: When bureaucratic decisions are influenced by lobbying or other rent seeking activities, there can be a substantial waste of real resources. This paper presents a simple classroom game in which students compete for a prize or "license" on the basis of costly lobbying expenditures. This game illustrates the extent to which rents can be dissipated in non-market allocations. The exercise can be used to motivate discussions of the efficiency and fairness properties of lotteries, auctions, and effort-based contests.

Keywords: rent seeking, lotteries, auctions, experimental economics, classroom experiments.

INTRODUCTION

There are many situations in which the allocation of a prize is determined by an effort-based competition. Large expenditures on lobbying in some contexts indicate that success probabilities are sensitive to such expenditures. Since contestants typically incur the costs of their efforts whether or not they are successful, there can be a substantial waste of real resources. These costs are greater when the lobbying activities have little or no social value, e.g., waiting in line, filling out lottery applications, or lobbying for "pork barrel" projects. Moreover, efforts to reduce the costs of rent-seeking activities may have the unintended effect that the contestants simply exert more effort. For example, making a waiting area more comfortable may induce people to arrive at a queue earlier (Holt and Sherman, 1982). Tullock (1967) argued that the cost of efforts exerted by all participants may be so large as to be a high fraction of the value of the prize, i.e. the economic rent may be largely dissipated. In the period from 1984 to 1989, for

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example, the U.S. Federal Communications Commission (FCC) awarded hundreds of regional cellular telephone licenses by lottery, and there were over 320,000 applications for 643 licenses. Hazlett and Michaels (1993) estimated that the real resources used in filing lottery applications added up to about 400 million dollars, for licenses with an estimated market value of approximately one billion dollars at that time. The FCC has since switched to using auctions.

This paper describes a simple classroom exercise in which students are endowed with resources (playing cards) that they can use as tickets in a lottery for a prize. A cost is incurred for each card used as a lottery ticket, so playing the cards in the lottery is like a costly effort that increases the chances of winning the prize. This exercise provides a useful way to explain the possible inefficiencies of effort-based competitions. In particular, it illustrates the extent to which economic rent can be dissipated, and it motivates discussion of lotteries, auctions, fixed allocation rules, and possible ways for enlightened bureaucrats and administrators to lower the social costs of rent-seeking behavior.

This exercise is appropriate for microeconomics courses at any level, and for courses in applied areas such as public economics, development, and regulation. In more technical courses like game theory, the incentive structure can also be used to illustrate calculations of a Nash equilibrium.

PROCEDURES

Playing cards and envelopes can be used to collect the students' decisions quickly and privately. The game will take about 50 minutes, including discussion. The only advance preparation is to obtain one or more decks of playing cards (under $2 per deck in a convenience store) and to make copies of the instructions in the Appendix. These instructions will fit on the front and back sides of a single sheet of paper.

Students will have an easier time understanding the social costs of effort-based competitions if you put the exercise into a specific economic context. The FCC lottery for cellular telephone licenses works particularly well, but the instructions in the Appendix could be adapted to a different context that is more appropriate to the subject content of a particular course.[1]

Begin by dividing students into teams or "investors" of up to three students each. There will be four investors competing for each prize or "license." One way to proceed is to put the four investor teams competing for a particular license in the same row (or adjacent rows) of desks, and have a separate deck of cards for each group of four investor teams. In larger classes, it helps to have a volunteer to handle the distribution of cards for each group of investors, as explained below.

All investor teams should receive an instruction sheet that they can use to record decisions and group earnings. Each team is given thirteen cards of the same suit and an initial capital account of $100,000. A team can play any of their thirteen cards by putting them in an envelope, so that no one else sees how many cards they play. Each card that is played can be thought of as a lottery ticket in a drawing for a license that is initially worth $16,000. Each lottery ticket costs the team $3,000, i.e. it costs this much to prepare the paperwork to file an application for the license lottery. Up to thirteen applications are allowed. (The values of the prize amount and application cost are selected to facilitate the equilibrium calculations for courses where these would be discussed.) The probability of winning the prize is determined solely by the number of cards a team plays, independent of which particular cards are played.

Begin with the set of competitors for the first license, e.g., the four teams in the first row or two. When all teams in this row have placed the cards they wish to play in their private envelopes, the volunteer for that row can collect the envelopes and put the cards that are played in a stack to be shuffled and cut. Announce the total number of cards in the stack, and draw the top card to determine which team wins the license value of $16,000. In addition the earnings of each team are decreased by $3,000 for each card played.

Students can record their decisions and earnings on the instruction sheet, which can be checked by the volunteer who distributes the cards. For simplicity, let them delete the three

[1] If you don't use the lottery interpretation, students will have trouble grasping the idea that the stochastic rule for determining the winner is an abstract model that captures some key features of effort-based competitions. If you use a lottery interpretation in which tickets are purchased in the usual manner, then the purchase is a transfer with no social cost, which will confuse students. The FCC license interpretation avoids these problems, and it also raises a very interesting comparison with the bandwidth auctions later used by the FCC.

zeros after each number. Earnings can be hypothetical.[2]

After the winner of the prize has been determined, sort the cards by suit and return them to the appropriate team, without revealing how many cards each team played. Since each team has only cards of one suit, there should be no confusion about the distribution of cards. While cards are being sorted and returned to one row, the four teams in the next row can be making their decisions.

Each round of decisions should take about five minutes. To broaden the discussion that follows, it is worthwhile to change the earnings structure for the second license, by decreasing the cost associated with filing a lottery application from $3,000 to $1,000. You can explain this as an efficiency move by the FCC that lowers the amount of paperwork and documentation required for an application. This decrease will lead to an increase in the number of cards being played, and so the total social cost of the applications may not decrease as much as expected, depending on the relevant elasticity. In larger classes you will not have time to go through both license costs for all rows. One solution is to have the competitors for licenses in some rows start with the $1,000 cost in line two of their record sheets.

Another useful change is to assign different prize values to reflect the fact that some investor teams might be more efficient at providing cellular service than others. This can be done by writing different numbers in the license value columns on the record sheets; do this in the rows for the third and fourth rounds. The third round can be used for a lottery as before. This asymmetric-values lottery should be done with one or more groups of four competitors until the license is not awarded to the team with the highest license value. This will facilitate later discussion of inefficiencies.

The fourth round can be used for an auction in which you, as auctioneer, begin calling out successively higher prices until only one bidder remains. This should be done as a standard "English auction" of the type used for antique and used car auctions. The winner has to pay the final bid, and the losers do not have to pay for a license that they do not win. There is no application fee for participating in the auction. The top two values should be separated by

[2] It is also possible to select a student at random ex post and pay that person a fraction of earnings, as explained in previous columns. This practice is probably not necessary in a game as competitive as the present one.

$2,000, so that you can raise the price in $1,000 increments and still have the high-value team win the auction. But keeping values relatively close together will help ensure that the previous lottery does not always select the team with the highest value. One possible set of values for rounds three and four is: $13,000, $14,000, $14,000, $16,000. These can be written by hand directly on the last two rows of the instruction/record sheet.

The discussion of net rents for the fourth round auction will be clearer if you designate one or more non-bidding members of the class as recipients of the revenue. The instructions refer to these people as "the poor." You should have no trouble finding volunteers for this role. The allocation of auction revenues to this group should make it clear that the bids are transfers, not expenditures of real resources.

To summarize: 1) obtain a deck of cards and four envelopes for each group of four teams, 2) make a copy of the instructions for each team, 3) write the asymmetric license values in the appropriate place for the third and fourth rounds, 4) assign the students to teams and form groups of four teams that compete for one license, 5) read the instructions out loud, take questions, and 6) start the first lottery. You can wait until after the third round to designate somebody (the "poor") as the recipient of the auction revenue in the final round.

DISCUSSION

People are going to want to talk about relative earnings, so ask which teams ended up with more capital than the $100,000 initial endowment after the three lottery rounds. If the lottery competition over-dissipated the rent, then some groups will have lost money. With a $3,000 application cost, for example, the teams in one class averaged 3.25 applications for each team, for a total cost of 3.25 x 3,000 x 4 teams = $39,000, which is more than twice the license value of $16,000.[3] Ask how can it be possible that giving away licenses that have significant value can actually make some (or all) of the contestants worse off. At this point it is worthwhile

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[3] This class was a section of economic statistics at the University of Virginia. There were eight two-person teams, divided into two groups. The teams in one group purchased 12 tickets and the teams in the other group purchased 14 tickets. We obtained similar results in Professor Michael Butler’s Spring 1997 industrial organization class at Texas Christian University. The teams in this latter class participated in four lotteries with the $1,000 cost, four lotteries with the $3,000 cost, and one lottery with asymmetric values. There was no clear time trend in applications over the four-lottery sequences, so we decided that a single lottery is sufficient to make the main points.

to take a particular group of four teams and add up their total earnings, net of initial cash endowment, for the lotteries (omit the earnings of the fourth round). These net earnings can be written on the board. Ask whether this is greater than the dollar value of all of the licenses obtained by lottery for all teams in this group. This should lead to a discussion of the real costs of rent-seeking efforts.

One way to reduce the real costs of the FCC lottery may be to reduce the paperwork requirements for filing an application. Students should evaluate this idea critically. Make sure that the discussion is related to the observed change in behavior when the application cost was reduced. The total number of applications almost always rises as the cost of an application falls, so total application costs may not fall as much as anticipated. For the class mentioned above, the average number of applications per team rose from 3.25 with the $3,000 cost to 6.4 with the $1,000 cost, so a two-thirds reduction in application cost only reduced total expenditures per team by one third, from about $9,750 to $6,400. The data here can also be used to review the concept of demand elasticity.

The responsiveness of the number of applications to the cost of an application raises one of the most important lessons that students can take from the study of economics: the awareness that naive extrapolations are inappropriate when behavior responds to changes in prices or other incentives. Let the students provide other examples, and supply some yourself. For example, the Economics Department at the University of Virginia recently began giving a single course reduction in teaching load to professors who agreed to teach a new course for the first time. This policy was stopped when it became clear that professors would switch to new courses at much higher rates than in the past.

Asymmetric-value lotteries can illustrate another inefficiency (in addition to the dissipation of the rent) that arises when prizes are awarded through an effort-based competition: the prize may not always go to the contestant who values it the most. (The teams with the highest value did not win the lottery in either of the two groups in our class.) Ask how this problem can be corrected, and hope for a response that mentions auctions, i.e. the bidder with the highest value can outbid the others in the auction. Note that this is what the price system does well, i.e. allocate goods and services to those who value them the most, and allocate production to those who can produce most efficiently. Finally, focus on the elimination of rent-seeking costs in the auction, by asking what the net earnings are for all four teams, together with the transfers to "the poor." The net rent will be the value of the license since the winning bid is just a transfer. Have students compare this net rent with the net rents obtained in the lotteries, for which net rents are typically negative.

A good way to move the discussion to broader issues is to note that the FCC has switched to an auction system that raised more than ten billion dollars in its first year.[4] Ask why auctions are not used more widely, say as a way to distribute computers to departments or course registration rights to students. This should raise issues of fairness, etc. For example, if students can bid for the right to register early for classes, then the wealthier students would have an advantage. You could request suggestions on improving such a procedure, and you might later mention that the Northwestern business school gives M.B.A. students equal budgets of "points" that they can use to in computerized auctions to bid for access to particular classes. This discussion should make it clear that sometimes there is a tradeoff between auctions that are more efficient and lotteries that are fairer. If a lottery is used, steps can be taken to reduce the real cost associated with the applications, for instance by only requiring personal information and limiting the number of applications.[5]

It may be necessary to point out that it is impractical or unethical to auction off many things, e.g. a government typically does not sell the right to have a new defense base located in one's own congressional district (except in cases of extreme corruption). Even where auctions are feasible, bureaucrats and administrators may prefer to award a license or other prize on the basis of subjective judgement or in response to lobbying. Let students explain why bureaucrats may enjoy being the focus of lobbying attention, or alternatively why administrators may have their own sincere beliefs and preferences for how licenses or other prizes should be allocated. It is useful to conclude with some personal experiences. One of us, for example, is a department chair who is frequently lobbying university officials and committees for fellowships, teaching prizes, endowed professorships, authority to hire new professors, etc. A considerable amount of

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[4] For years Congress opposed the use of auctions in response to political pressures from communications companies. McMillan (1994) describes the role of economic analysis in the design of these auctions for communications licenses.

[5] Lotteries with application fees are "raffles" that can be used for fund raising.

costly rent-seeking behavior could be avoided if things like computer budgets were just allocated on the basis of a formula, instead of being given out in competitions or to departments who make special cases.

The competition for a prize via costly lottery applications is a concrete physical process that students easily visualize. It is harder, but very important, to get them to realize that the lottery setup can be thought of as a *model* that economists use to think about effort-based competitions. Suppose that there are several more-or-less equally qualified contestants for a license or government contract, and that the administrator or panel making the award decision is influenced by fancy presentations, extensive paperwork, early applications, etc. If all contestants spend an equal amount of money on lobbying, then they should each have an equal chance of winning the prize, just as in a lottery where each purchases the same number of tickets. The lottery model also has the property that the probability of obtaining the prize is increasing in one's own expenditure and decreasing in the expenditures of others. Ask for examples of situations in which spending more time and money increases one's chances of obtaining some desired good or service.

The lottery setup discussed above is fair in the sense that all participants have the same chances of winning when they spend equal amounts on lobbying. In some cases, however, one contestant has a natural advantage. Let the students provide some examples (e.g., one side may have a better case in a legal proceeding). Ask how the lottery model can be changed to reflect an advantage that one contestant may have over the others.[6] The point to make is that the implications of this classroom exercise are much broader that they first appear. This discussion can be tied to empirical estimates of rent seeking expenditures; see the references that follow.

In addition to the important economic lessons of the exercise, it can be used to illustrate the calculation of a Nash equilibrium in more advanced courses. For the $3,000 application cost lottery, the Nash equilibrium is to play one card. This can be verified by calculus in a

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[6] Suppose the player with the advantage chooses a level of expenditures denoted by E and that three other players each choose expenditures on lobbying denoted by E*. Then the advantaged player's probability of winning could be:

$$\frac{(1+k)\,E}{(1+k)\,E + E* + E* + E*} \ .$$

straightforward manner.[7] A less technical approach is to calculate expected net rents for deviations from the equilibrium. When all others are playing a single card, then playing only one card results in a 1/(1+1+1+1) = 1/4 chance of winning, and the expected payoff is: 16*(1/4) - 3 = 1 (thousand dollars), when the application cost is 3. Reducing the number of applications to zero will yield a lower expected payoff, $0. Similarly, a unilateral increase one's own applications, to 2, will raise the probability of winning to 2/(2+1+1+1) = 2/5, but the expected payoff will go down from 1 to: 16*(2/5) - 2*3 = 32/5 - 6 = 2/5. To make sure that students understand these calculations, let them show that the equilibrium number of applications increases to three when the cost of applications falls to 1 (thousand). This makes a good homework problem, along with a question about what happens to total expenditures on applications (it does not change, so the demand elasticity is unity).

FURTHER READING

The magnitude of the social cost caused by rent-seeking behavior was first estimated by Krueger (1974) for various developing countries. For example, she found that in India the annual welfare costs of rent seeking induced by price and quality controls was about 7 percent of GNP. Posner (1975) estimates that the social cost of regulation in the U.S. to be up to 30 percent of sales for some industries. For the FCC cellular telephone bandwidth lotteries, the estimates in Hazlett and Michaels (1993) indicate that application preparation expenses dissipated about 38 percent of the rents associated with the bandwidth being distributed. In contrast, the FCC switch to auction allocations in 1995 seemed to produce little rent-seeking activity, and the auctions raised over ten billion dollars.

The game studied in this paper naturally applies to lobbying situations (Hillman and Samet, 1987), since the expenditures incurred in the competition for a government grant, license, or contract are usually not reimbursed. Other applications include R&D races, political contests, and promotion tournaments. Millner and Pratt (1989) conducted some two-player rent-seeking

[7] Suppose that the other three teams use their equilibrium numbers of applications, denoted by N* for each of them. Then the probability of winning the lottery with N applications is N/(N + 3N*). The expected payoff, in thousands of dollars, is: 16N/(N + 3N*) - 3N. First take the derivative of this with respect to N and equate it to zero. Then impose symmetry by setting N = N*, and solve to obtain N* = 1.

experiments in which the probability of obtaining the prize is the subject's fraction of total effort. The rate of rent dissipation in the final period was 60 percent, slightly but significantly greater than the Nash prediction of 50 percent dissipation. Millner and Pratt (1991) report that groups of less risk averse subjects compete more aggressively and dissipate a larger fraction of the rent (68 percent versus 54 percent for more risk averse subjects).

APPENDIX: INSTRUCTIONS

This is a simple card game. You have been assigned to a team, which is a group of investors who are bidding for a local government communications license that is worth $16,000 to the winner. The government has decided to allocate the licenses by choosing randomly from the applications received. The paperwork and legal fees associated with each application will cost your team $3,000, regardless of whether you obtain the license or not. Each team is permitted to submit any number of applications, up to a limit of thirteen per team in each lottery. Your team begins with a working capital of $100,000.

I will divide the teams into groups of four, so that there will be four teams competing for each license. To implement the lottery, each of the four teams in competition will be given thirteen cards, all of the same suit. The exercise will consist of a number of rounds. In each round, your team will play *any* number of your cards by placing them in an envelope provided. Each card you play is like a lottery ticket in a drawing for a prize of $16,000. All cards that are played by your team and the other teams will be placed on a stack and shuffled. Then one card will be drawn from the deck. If that card is one of the cards your team played (a card that matches your suit), your team will win $16,000. Otherwise you receive nothing from the lottery. Whether or not you win the lottery, your earnings will decrease by $3,000 for each card that you play. To summarize, your earnings for the round will be calculated:

earnings = $16,000 if you win the lottery
- $3,000 times the number of cards you play.

Earnings will be negative for those who do not win the lottery, and negative earnings are indicated with a minus sign in the record table below. Note that the cumulative earnings column on the right begin with $100,000, reflecting your initial financial capital. Earnings should be added to or subtracted from this amount, to keep track of cumulative earnings. In making your decisions, remember that you and the others on your team plan to divide up the final amount of capital in the cumulative earnings column. Are there any questions?

round	number cards played	$ per card played	cost of cards played	license value	your total earnings this round	cumulative earnings
						$100,000
1	_____	$3,000	_____	$16,000	_____	_____

In the next lottery, your team begins again with thirteen cards, but the cost of each card played is reduced to $1,000. This could reflect a government efficiency move that requires less paperwork for each license application. This license is worth $16,000 as before, whether or not your team already acquired a license.

round	number cards played	$ per card played	cost of cards played	license value	your total earnings this round	cumulative earnings
2	_____	$1,000	_____	$16,000	_____	_____

In the next lottery, note that the value of the license to you has changed, i.e. it is no longer $16,000 for all teams. Teams may have different license values, reflecting the fact that some teams are more efficient than others in providing the communications service in the market where this third license is awarded. The cost of each card played is $1,000.

round	number cards played	$ per card played	cost of cards played	your license value	your total earnings this round	cumulative earnings
3	_____	$1,000	_____	$______	_____	_____

In the final round, the license will be worth the same to you as it was in round 3, but there is no lottery and no application fee. Instead, I will conduct an auction by starting with a low price of $8,000 and calling out successively higher prices until there is only one team actively bidding. The winning team will have to pay the amount of its final bid. The losing teams do have to pay anything for the license that they did not purchase; the winning team earns an amount that equals its license value minus the price paid. The revenue from the auction will be allocated to one or more (deserving) people, "the poor," who do not participate in the auction:

round	your license value	your earnings (license value - price paid if you win) ($0 if you do not win the auction)
4	$_____	$_____

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